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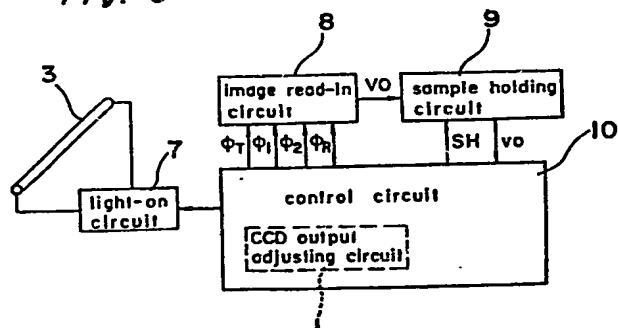
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CCD sensor output circuit of image reading apparatus.

A CCD sensor output circuit of an image reading apparatus adapted to output a stable reading signal from the CCD sensor even if the light source changes in temperature due to heating. One portion of a region to be read by a CCD sensor is made to serve as a reference region, in accordance with the output of the CCD sensor corresponding to the reference region when the light source has been turned on according to a lighting control signal, the reflected lights from the images are made to read by the CCD sensor at a first timing after the light source has been made stable, and the output of the CCD sensor is adapted to be transferred at a given second timing from the first timing to the outputting of the next lighting control signal, thus providing the CCD sensor output after the light source has been made stable.

Fig. 3



CCD SENSOR OUTPUT CIRCUIT OF IMAGE READING APPARATUSBACKGROUND OF THE INVENTIONFIELD OF THE INVENTION

The present invention relates to a CCD sensor output circuit of an image reading apparatus and more particularly, to improvements in a CCD sensor output circuit in an image reading apparatus, which is adapted to detect by a CCD sensor the lights coming from the light source reflected by images so as to read the images.

DESCRIPTION OF THE PRIOR ART

Conventionally, Fig. 1 is a view showing an optical system in an image reading apparatus, to which one embodiment of the present invention is applied. Referring to Fig, 1, lights from a white colored fluorescent lamp 3 are applied upon a color manuscript 2 if the color manuscript 2 is arranged before a white-colored back plate 1. The lights from the white-colored fluorescent lamp 3 reflected by a color manuscript 2 are reflected by a mirror 4, are focused and are inputted to a CCD sensor 6.

An image reading portion using such a CCD sensor 6 as shown in Fig. 1 may be used in facsimile OCR, color scanner or the like. In such an image reading apparatus, the white-colored fluorescent lamp 3 has disadvantages in that the radiation amount changes due to differences in its ambient temperature or the changes of the radiation amount through rises in guide temperature to be raised by

self-heating after the lighting become large. As a measure against them, there are adopted methods of using an automatic gain control circuit (AGC circuit) or flashing a white-colored fluorescent lamp to change its lighting width  
5 thereby controlling the radiation amount. However, disadvantageously a proper circuit is not provided which precisely controls high-speed analog signal as an AGC circuit. A method of varying the lighting width of the white-colored fluorescent lamp 3 becomes unstable in  
10 lighting when the lighting duty cycle becomes extremely small.

#### SUMMARY OF THE INVENTION

Accordingly, an essential object of the present invention is to provide a CCD sensor output circuit of an  
15 image reading apparatus which may output a stable reading signal from a CCD sensor even if the light source changes in temperature due to heating.

In accomplishing the object of the present invention, according to one preferred embodiment of the  
20 present invention, there is provided a CCD sensor output circuit which is adapted to adjust the changes in the output level of said CCD sensor through the changes in the temperature of said light source in accordance with the CCD sensor output of a reference region to be read by said CCD  
25 sensor in an image reading apparatus for reading the images through detection, by the CCD sensor, of the lights from a light source reflected by the images, comprising, an output adjusting means which decides how said light source has been

made stable, in accordance with an output signal  
corresponding to said reference region among the output  
signals of said CCD sensor, to adjust the reading output of  
the CCD sensor, a lighting control means for lighting said  
5 lighting only for a time period at a predetermined period, a  
timing signal output means for outputting timing signals at  
a first timing after said output adjusting means has reached  
the stable condition of said light source after the lighting  
of said light source in synchronous relation with the  
10 lighting control signal from said lighting control means,  
and at a given second timing from the timing of said stable  
condition to outputting of the next lighting control signal,  
and a transfer control means which causes said CCD sensor to  
read the reflected lights from said images by a timing  
15 signal in a first timing outputted from said timing signal  
output means so as to transfer the outputs of said CCD  
sensor at a second timing. With this construction, the  
reflected lights from the images are adapted to be read by a  
CCD sensor at a first timing after the light source has  
20 become stable, in accordance with the output of the CCD  
sensor corresponding to a reference region when the light  
source has been lighted according to a lighting control  
signal with one portion of a region, to be read by the CCD  
sensor, as a reference region. The CCD sensor output after  
25 the light source has been stable is adapted to be provided  
through the transferring of the CCD sensor output at a given  
second timing to the outputting of the next lighting control  
signal from the first timing.

BRIEF DESCRIPTION OF THE DRAWINGS

This and other objects and features of the present invention will become apparent from the following description taken in conjunction with the preferred embodiment thereof with reference to the accompanying drawings, in which:

Fig. 1 is a view showing an optical system in an image reading apparatus, already referred above.

Fig. 2 is a view showing a principle for controlling the CCD output, in one embodiment of the present invention, within a constant range;

Fig. 3 is a schematic block diagram of an optical systems in one embodiment of the present invention;

Fig. 4 is a detailed block diagram of an image reading portion shown in Fig. 3; and

Fig. 5 and Fig. 6 are wave-form views of each portion of Fig. 3 and Fig. 4.

DETAILED DESCRIPTION OF THE EMBODIMENTS

Referring to Fig. 2, a reference region 11 before which a color manuscript 2 does not pass in any case is provided in the white-colored back plate 1. The reference region 11 is provided to adjust the output of the CCD sensor 6 shown in Fig. 1. The reflected lights from the white-colored fluorescent lamp 3 reflected by the reference region 11 are inputted into the CCD sensor 6 through a lens 5. A signal corresponding to the reference region 11 among the output signals of the CCD sensor 6 is detected in its

level by the CCD output adjusting circuit 12 shown in Fig. 3 so that its level is controlled within a constant range.

Referring to Fig. 3, the white-colored lamp 3 is turned on by a lighting circuit 7 in accordance with a lighting

5 control signal from a control circuit 10. As described hereinabove, the control circuit 10 is adapted to control the level of the CCD output within a constant range in

accordance with an output signal of the CCD sensor 6 corresponding to a reference region 11. Also, the control

10 circuit 10 feeds a transfer pulse  $\phi_T$ , clock pulses  $\phi_1, \phi_2$  and a reset pulse  $\phi_R$  to the image reading portion 8. The image

reading portion 8 is adapted to read the images in accordance with the reflected lights from the color

manuscript 2 and an image signal VO read out is fed to a sample hold circuit 9. A sampling pulse SH is fed from the

15 control circuit 10 to the sample hold circuit 9. The sample hold circuit 9 holds in sample the reading signal VO from the image reading portion 8 in accordance with the sampling

pulse SH. The output signal VO sample-held is fed to the

20 control circuit 10.

The detailed construction of the image reading portion 8 shown in Fig. 3 will be described hereinafter with reference to Fig. 4. A CCD sensor 81 outputs light

electric-charges in accordance with the reflected lights

25 from the images. The light electric-charges are fed to a transfer gate 82. A transfer pulse  $\phi_T$  is fed to the

transfer gate 82 and the light electric-charges from the

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CCD sensor 81 is transferred to an analog shift register 83 in accordance with the transfer pulse  $\phi_T$ . The clock pulses  $\phi_1, \phi_2$  are fed to the analog shift register 83. The analog shift register 83 sequentially outputs the light

5 electric-charges of the CCD sensor 81 transferred from the transfer gate 82 in accordance with the clock pulses  $\phi_1, \phi_2$  to feed them to an output buffer 84. The output buffer 84 sequentially outputs the image data shifted from the analog shift register 83 in accordance with the reset pulse  $\phi_R$ .

10 The operation of an image reading apparatus shown in Fig. 3 and Fig. 4 will be described hereinafter with reference to Fig. 5 and Fig. 6, showing the wave form views of each portion of Fig. 3 and Fig. 4. A flashing circuit 7 flashes a white-colored fluorescent lamp 3 in accordance with a lighting control signal FL to be given from the

15 control circuit 10. The lights from the white-colored fluorescent lamp 3 are applied upon the color manuscript 2 and the reference region 11 of the white-colored back plate 1. The reflected lights from the images and the reflected

20 lights from the reference region 11 through the lights from the white-colored fluorescent lamp 3 are detected by the CCD sensor 81. Namely, the light electric-charges corresponding to the reflection lights of the images are accumulated upon such as regions  $S_1$  through  $S_{N-3}$  among the respective regions

25  $S_1, S_2, S_3 \dots S_{N-1}, S_N$  shown in Fig. 4 on the CCD sensor 81, and the light electric-charges corresponding to the reflected lights from the reference region 11 are accumulated upon the regions  $S_{N-2}$  through  $S_N$ . When the

transfer pulse  $\phi_T$  is fed to the transfer gate 82, the light electric-charges accumulated on the respective regions  $S_1$ ,  $S_2$ ,  $S_3 \dots S_{N-1}$ ,  $S_N$  of the CCD sensor 81 are loaded on the regions  $SR_1$ ,  $SR_2$ ,  $SR_3$ , ...  $SR_{N-1}$ ,  $SR_N$  of the analog shift register 83.

The analog shift register 83 transfers the loaded contents to an output buffer 84 in accordance with the clock pulses  $\phi_1$ ,  $\phi_2$ . The output buffer 84 photoelectrically converts the light electric-charges transferred from the analog shift register 83 to output them as an CCD output signal VO.

It is to be noted that light electric charges which are sequentially transferred from the analog shift register 83 are reset each time within the output buffer 84 by a reset pulse  $\phi_R$ . Accordingly, the CCD sensor output signals  $VO_1$ ,  $VO_2$ ,  $VO_3$ , ...  $VO_N$  corresponding to the light electric-charges accumulated on the respective regions  $S_1$ ,  $S_2$ ,  $S_3$ , ...  $S_{N-1}$ ,  $S_N$  are outputted from the CCD sensor 81. They are the normal CCD output signals.

The characteristic portions of the present invention will be described hereinafter with reference to Fig. 6. In one embodiment of the present invention, one scanning period from the initial lighting of the white-colored fluorescent lamp 3 to the next lighting thereof is divided among a  $T_{on}$  period, a  $T_{off}$  period, and a  $T_{read}$  period as shown in Fig. 6 (a), and one unit of scanning period is composed of a scanning period  $S_{flon}$  of a timing the white-colored fluorescent lamp 3 radiates, and a



scanning period  $S^{\text{read}}$  of a timing using the output of the  
 CCD sensor 81. Also, assume that the scanning of the CCD  
 sensor 81 is composed of  $M, M+1, M+2, M+3$ . And at the  
 radiation timing of each scanning, the white-colored lamp 3  
 5 normally lights only during the same time  $T_{NM}$ .

In the period  $S_M^{\text{FLON}}$  of the radiation timing in  
 the scanning period  $M$ , the transfer pulse  $\phi_T$  is the interval  
 "H" of the time  $T\phi_T$ . Accordingly, the light  
 electric-charges in the CCD sensor 81 to be caused by the  
 10 radiation 111 (Oblique line portion shown in Fig. 6 (b) of  
 that intervals are transferred to the analog shift register  
 83 simultaneously with the production of the light  
 electric-charges. Namely, the light electric-charges are  
 transferred to the analog shift register 83 simultaneously  
 15 with the production, because the analog shift register 83 is  
 lower in electric potential to electrons than the CCD sensor  
 81 when the transfer pulse  $\phi_T$  is "H". And when the transfer  
 pulse  $\phi_T$  changes from "H" to "L", the light electric-charges  
 to be caused by the radiation amount of its subsequent  
 20 white-colored fluorescent lamp 3 are accumulated on the CCD  
 sensor 81. Also, simultaneously with change from the "H" to  
 the "L" of the transfer pulse  $\phi_T$ , clock pulses  $\phi_1, \phi_2$  are  
 fed to the analog shift register 83 and the output  $VO_M$  of  
 the CCD sensor 81 corresponding to the light  
 25 electric-charges produced during the transfer pulse  $T\phi_T$  is  
 sequentially outputted.

A transfer pulse  $\phi_T$  of comparatively short width  
 is given to the transfer gate 82 after the further lapse of

the  $T_{\text{off}}$  time after the radiation time  $T_{\text{on}}$  of the white-colored fluorescent lamp 3 has passed. And the transfer gate 82 transfers to the analog shift register 83 the light electric-charges accumulated on the CCD sensor 81 for a time period ( $T_{\text{on}} - T\phi_T$ ) the white fluorescent lamp 3 turns off after the lapse of the  $T\phi_T$  of the transfer pulse  $\phi_T$ . Also, the light electric-charges transferred to the analog shift register 83 are sequentially shifted by the clock pulses  $\phi_1$ ,  $\phi_2$  and sequentially outputted as the output  $VO_M^{\text{READ}}$  of the CCD sensor 81.

A  $T_{\text{READ}}$  period after a pulse of the comparatively short width among the transfer pulse  $\phi_T$  is assumed to be a scanning period  $S_M^{\text{READ}}$ . Accordingly, in Fig. 6, assume that no drifts in temperature are provided in the radiation output of the white-colored fluorescent lamp 3, and the output of the CCD sensor 81,  $VO^{\text{FLON}} + VO^{\text{READ}}$  becomes constant. It is apparent from the above-description that the amount of the output  $VO^{\text{READ}}$  of the CCD sensor 81 to be produced during the  $T_{\text{READ}}$  period using the output of the CCD sensor 81 can be controlled in accordance with the width of the transfer pulse  $\phi_T$ .

The reason why the  $T_{\text{OFF}}$  period has been determined will be described. As the  $T\phi_T$  of the transfer pulse  $\phi_T$  comes closer to the  $T_{\text{on}}$  period, the output  $VO_M^{\text{FLON}}$  of the CCD sensor 81 in the radiation timing  $S_M^{\text{FLON}}$  is outputted to the period of  $T_{\text{off}}$ . Although the precise radiation spectrum has to be used generally when the white-colored fluorescent lamp 3 is used as a light source for reading the color

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manuscript, the radiation spectrum immediately after the white-colored fluorescent lamp 3 has been lit on and the radiation spectrum after the stable lighting has been provided are somewhat different from each other as shown in Fig. 6 (b). Namely, time taken from the output of the lighting signal FLON shown in Fig. 6(a) to the actual lighting of the white-colored fluorescent lamp 3 is dispersed each time, and the time taken before the stable lighting has been provided is also dispersed. The minimum width of the transfer pulse  $\phi_T$  at the radiation timing is restricted to the time  $T_{MIN}$  (see the scanning period  $M+3$  in Fig. 6) taken for the white-colored fluorescent lamp 3 to reach its stable lighting so that the output  $VO^{READ}$  of the CCD sensor 81 to appear at a timing for using the output of the CCD sensor 41 by the radiation after the white-colored fluorescent lamp 3 has reached its stable lighting. Thus, the control circuit 10 shown in Fig. 3 determines the falling timing of the transfer pulse  $\phi_T$ , in accordance with a reading signal corresponding to the regions  $S_{N-2}$  through  $S_N$  of the CCD sensor 81 corresponding to the reference region 11, so that the CCD output adjusting circuit 12 may vary the width of the transfer pulse  $\phi_T$  at time  $T_{MIN}$  or more to control the CCD output within a constant range. Namely, the control circuit 10 makes long the period  $T_{\phi_T}$  of the "H" of the transfer pulse  $\phi_T$  in the next scanning if the output signal level of the CCD sensor 81 corresponding to the reference region 11 of the white-colored back plate 1 is higher than a certain reference level, and makes the period

$T\phi_T$  if the output signal level is lower than a certain reference level so as to control so that the level of the output  $VO^{READ}$  to appear at the scanning period  $S_M$  of a timing using the output of the CCD sensor 81 may become within a certain range.

In the above description, the transfer pulse  $\phi$  was adapted to become "H" only during the  $T\phi_T$  period in the radiation timing as shown in Fig. 6 (b), but it is not restricted to the above description. The pulse signal of comparatively short width may be constructed to be outputted when the white-colored fluorescent lamp 3 has reached its stable condition, not that the pulse signal is outputted for a period the white-colored fluorescent lamp 3 becomes stable as shown in Fig. 6 (e).

Also, in the embodiment of the present invention, explanation has been given about adjustment of the output level degree of the CCD sensor through changes in the temperature of the light source by the white-colored fluorescent lamp 3. Explanation may be given about each ray of light of three primary colors of the color image reading apparatus.

Thus, in accordance with the present invention, it is so arranged that one portion of a region to be read by a CCD sensor is made to serve as a reference region, in accordance with the output of the CCD sensor corresponding to the reference region when the light source has been turned on according to a lighting control signal, the reflected lights from the images are made to read by the CCD

sensor at a first timing after the light source has been made stable, and the output of the CCD sensor is adapted to be transferred at a given second timing from the first timing to the outputting of the next lighting control  
5 signal, thus providing the CCD sensor output after the light source has been made stable.

Although the present invention has been fully described by way of example with reference to the accompanying drawings, it is to be noted here that various  
10 changes and modifications will be apparent to those skilled in the art. Therefore, unless otherwise such changes and modifications depart from the scope of the present invention, they should be construed as being included therein.

WHAT IS CLAIMED IS

1. A CCD sensor output circuit which is adapted to adjust the changes in the output level of said CCD sensor through the changes in the temperature of said light source in accordance with the CCD sensor output of a reference  
5 region to be read by said CCD sensor in an image reading apparatus for reading the images through detection, by the CCD sensor, of the lights from a light source reflected by the images, comprising:

10 An output adjusting means which decides how said light source has been made stable, in accordance with an output signal corresponding to said reference region among the output signals of said CCD sensor, to adjust the reading output of the CCD sensor,

15 a lighting control means for lighting said lighting only for a time period at a predetermined period,

20 a timing signal output means for outputting timing signals at a first timing after said output adjusting means has reached the stable condition of said light source after the lighting of said light source in synchronous relation with the lighting control signal from said lighting control means, and at a given second timing from the timing of said stable condition to outputting of the next lighting control signal, and

25 a transfer control means which causes said CCD sensor to read the reflected lights from said images by a timing signal in a first timing outputted from said timing

signal output means so as to transfer the output of said CCD sensor at a second timing.

2. A CCD sensor output circuit of an image reading apparatus in accordance with claim 1, wherein said output adjusting means is adapted to adjust a time period for outputting said first timing signal or the width of said first timing signal so that the output signal of the CCD sensor to be outputted to said second timing may become a given level.

3. A CCD sensor output circuit of an image reading apparatus in accordance with claim 2, wherein said reference region is provided in one portion of a region to be read by said CCD sensor, said output adjusting means is adapted to adjust a time period for outputting said first timing signal to the next region or the width of said first timing signal in accordance with the CCD sensor output read out in said first region.

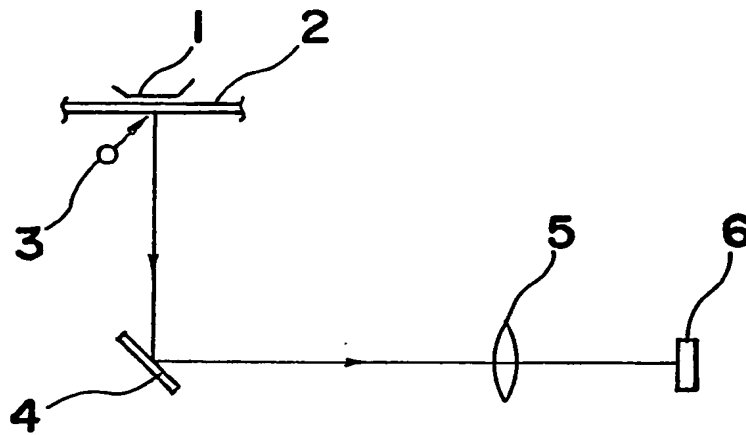
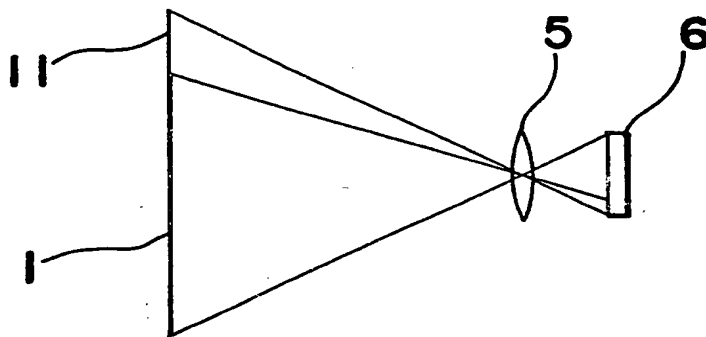
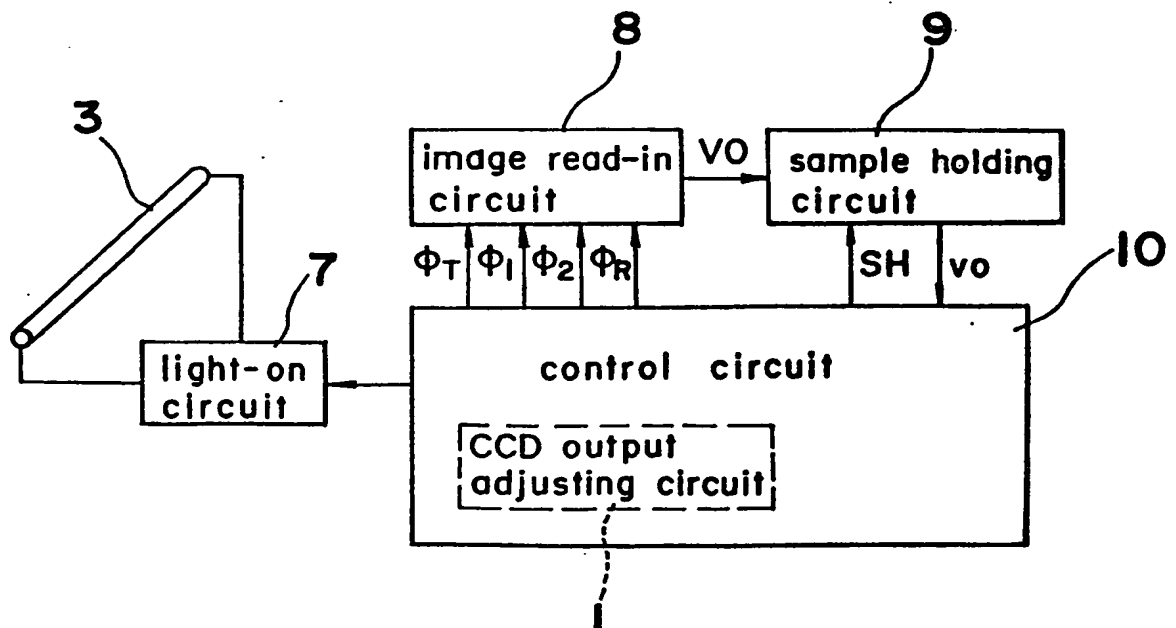
*Fig. 1**Fig. 2**Fig. 3*



Fig. 4

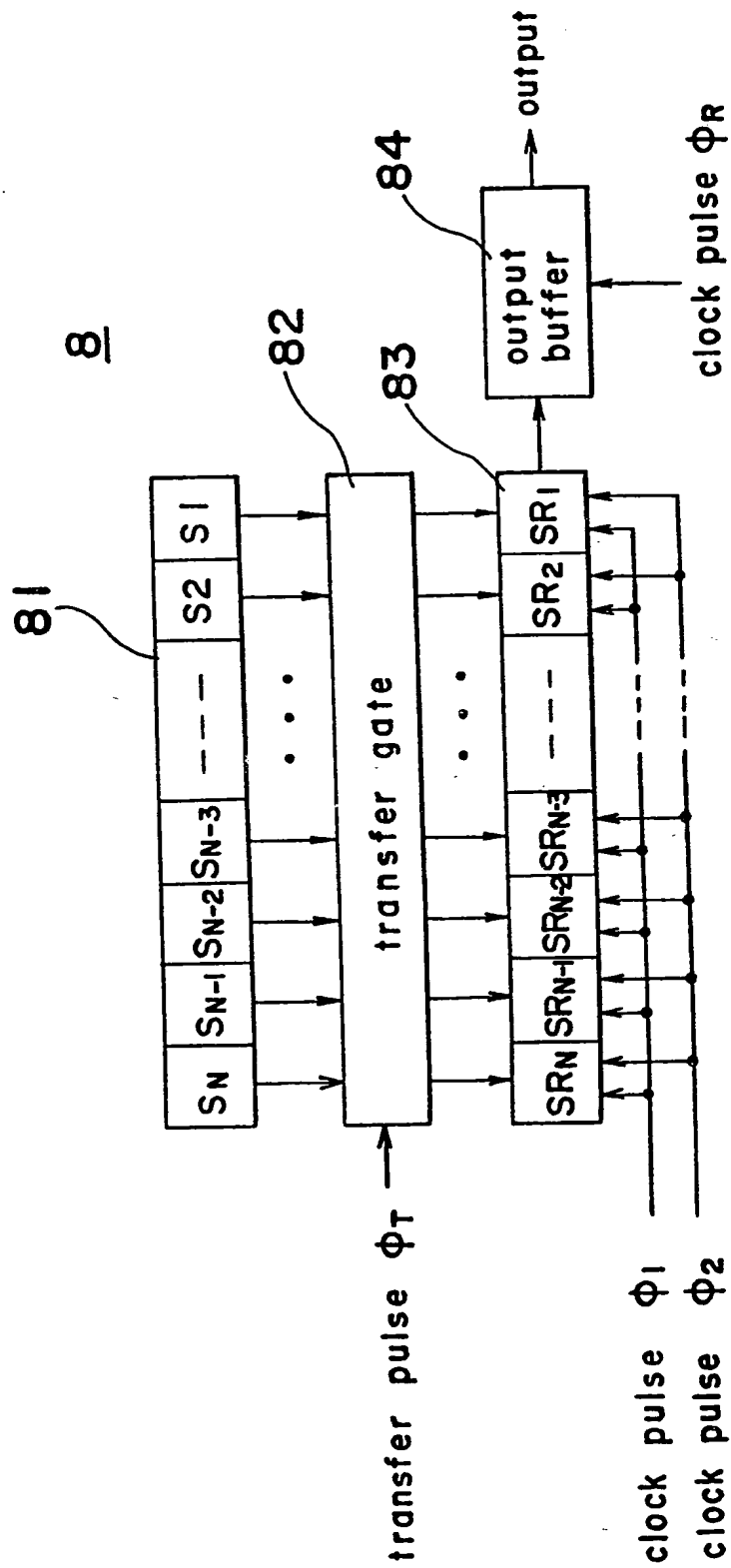
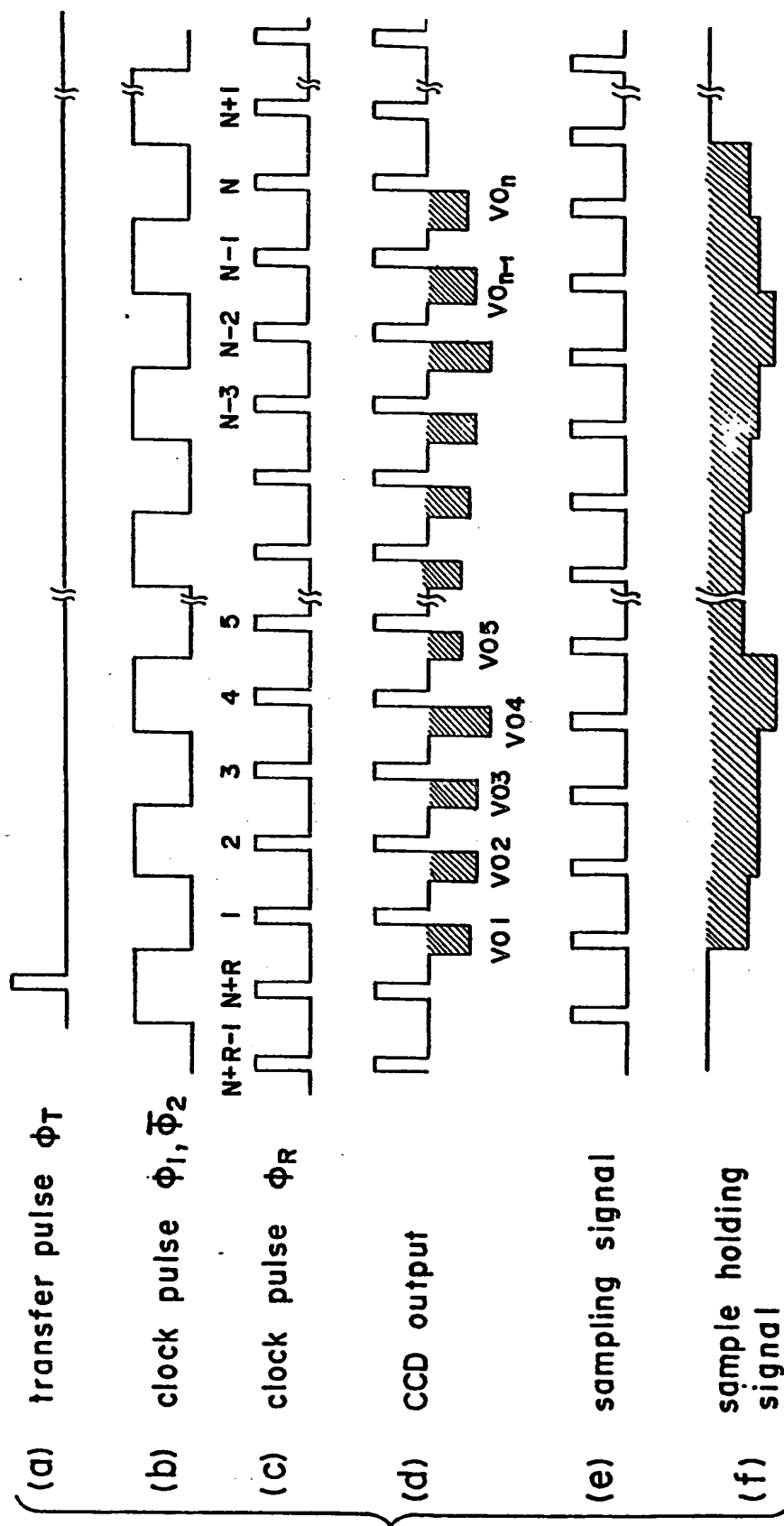


Fig. 5



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Fig. 6

